Remarks

Reconsideration of the subject application is requested in view of the following remarks. New claim 82 is submitted for consideration. Upon entry of this Amendment, claims 51-53 and 72-82 are in the application.

Support for new claim 82 can be found in the specification at, for example, FIG. 2 and page 6, lines 15-27. No new matter is introduced.

Rejections under 35 U.S.C. § 112

Claims 51-53, 72-77, and 81 stand rejected under 35 U.S.C. § 112 as allegedly containing subject matter not described in the specification and not being enabled by the specification. This rejection is traversed. The Office action alleges that the combination of a ruthenium-containing layer having a non-textured surface and a textured surface is new subject matter because FIG. 2 of the application shows a ruthenium layer having two major surfaces, "but both are textured because of the gap areas forming the textured pattern." Office action at page 2, paragraph 1. Even if a layer having gaps must have two textured major surfaces as the Office action contends, a layer having such gaps is only one example of a roughened ruthenium layer:

> "Although the example roughened ruthenium layer 16 shown in the figures is discontinuous, this is by way of example only and continuous films may be produced. Increased thickness of the layer 12 tends to produce more continuous films, as does reduced temperature and increased pressure during the anneal and reduced anneal time." Specification, page 6, lines 23-27.

Thus, the specification describes ruthenium layers that do not have gaps and can thus have both a textured surface and a non-textured surface. In addition, the specification teaches how such layers can be made. Therefore, withdrawal of this rejection is requested.

The Office action also states that both major surfaces of a discontinuous ruthenium layer are textured because of the gaps in the layer. This is false. The non-textured surface of such a discontinuous layer is the portion of the ruthenium layer surface that is adjacent to a supporting structure. The remaining portions of the ruthenium layer that are not adjacent the supporting structure (i.e., the curved outer surfaces of the ruthenium protrusions in FIG. 2) form a textured surface. This configuration is illustrated in the figures below, adapted from FIG. 2 of the above-referenced patent application. Both a non-textured surface and a texture surface are shown.

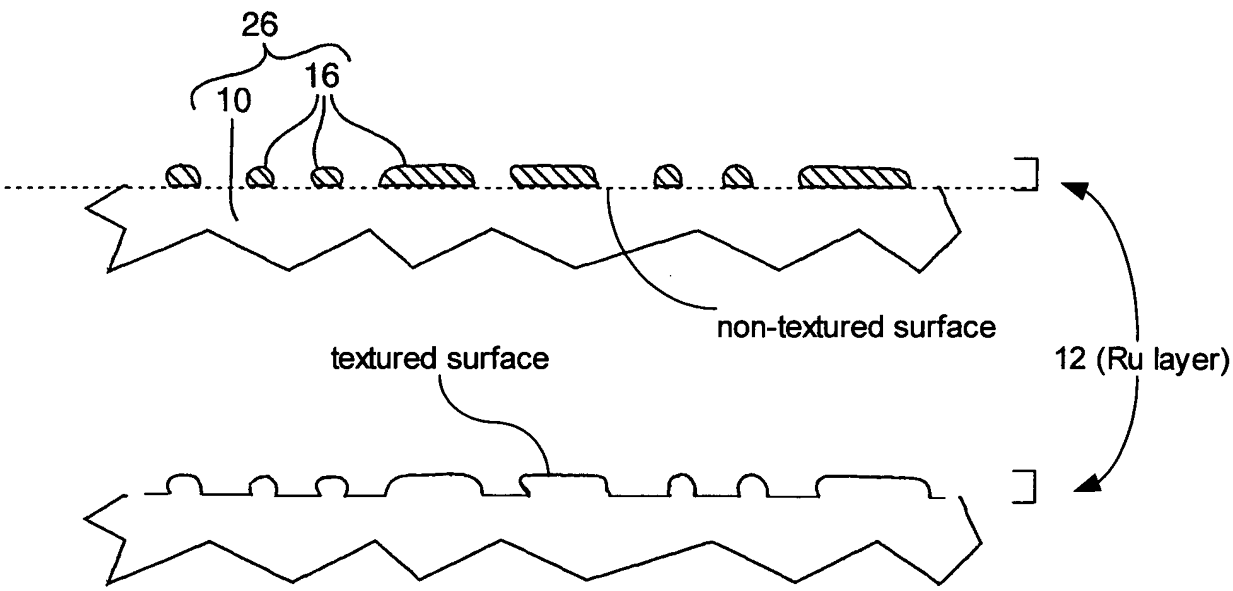

FIG. 2

A ruthenium containing layer having a non-texutured surface and a textured surface.

As noted above, in other examples, the ruthenium layer is continuous, and there are no gaps in the layer. In these examples, the ruthenium layer continues to have both a non-textured surface and a textured surface.

Rejections under 35 U.S.C. § 102

Claims 51-53 and 72-73 stand rejected as allegedly anticipated by Uzoh et al., U.S. Patent 6,409,904 (Uzoh). This rejection is traversed. Uzoh teaches a conductive layer, such as a copper layer, that is plated over a seed layer of copper or gold. Col. 5, lines 16-19 and col. 6, lines 18-20. Conductive layers according to Uzoh retain the grain structure of the seed layer on which they are formed, and therefore do not have and cannot have both a non-textured surface and a non-textured surface as recited in the pending claims. Therefore, claims 51-53 and dependent claims 72-77 are properly allowable over Uzoh.

Claims 51, 74-77, and 78-80 stand rejected as allegedly anticipated by Takemura, U.S. Patent 6,218,233 ("Takemura"). This rejection is traversed. Claims 51 and 74-77 recite a ruthenium-containing layer having a non-textured surface adjacent a supporting structure and a textured surface with a mean feature size of at least about 100 Angstroms opposite the non-textured surface. Takemura discloses, for example, ruthenium films and a ruthenium oxide bottom electrode and a ruthenium plate electrode (see items 12, 21, and 13, respectively, in Fig. 14) and an amorphous ruthenium oxide bottom electrode (see item 42 in Fig. 5). None of these surfaces are shown as roughened or textured surfaces. Takemura does state that conductive oxide files typically exhibit surface roughness of about 1.2 nm (12 Å) due to the presence of pillar-shaped crystal structures, and describes how this surface roughness can be reduced to improve breakdown voltage. Col. 18, lines 26-34 and lines 14-20. Takemura does not teach or suggest ruthenium-containing films having a mean feature size of about 100 Å as recited in claims 51 and 74-77, and teaches away from such textured surfaces. Accordingly, claims 51 and 74-77 are properly allowable over Takemura.

Claim 78 recites an integrated circuit that has a supporting structure that includes a conductive plug and an enhanced-surface-area electrically conductive ruthenium-containing layer situated on the supporting structure. As noted above, Takemura does not teach or suggest enhanced-surface-area electrically conductive layers. Instead, Takemura teaches making surfaces of conventional conductive layers even smoother to improve breakdown voltage. Therefore, claim 78 and dependent claims 79-81 are properly allowable over Takemura.

New claim 82 recites an integrated circuit that comprises a supporting structure and an enhanced-surface-area electrically conductive ruthenium-containing layer situated on the supporting structure. The ruthenium-containing layer has a plurality of protrusions extending outwardly from a surface of the supporting structure, the protrusions having first major surfaces adjacent the supporting structure and second major surfaces facing outward from the surface of the supporting structure, wherein the first major surfaces are substantially planar and the second major surfaces are substantially non-planar and include portions extending at least about 100 Angstroms from the first major surfaces. Neither Uzoh nor Takemura teaches or suggests such an integrated circuit. Uzoh teaches conductive layers that retain the grain structure of the seed layer on which they are formed, and therefore do not have a substantially planar surface. Takemura teaches making surfaces of conventional conductive layers that include pillar-shaped crystal structures that are about 12 Angstrom tall even smoother, and does not teach or suggested the substantially larger (at least about 100 Angstrom) protrusions claimed. Thus, Takemura does not teach or suggest the integrated circuit of claim 82.

In view of these remarks, all claims are believed to be in condition for allowance and action to such end is requested.

Respectfully submitted,

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